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Far-IR Transmission Spectroscopy of Superconducting MgB_2

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Far-infrared spectroscopy is a standard method for extracting information on metals and superconductors. When thin films are available, transmission measurements become feasible and allow the electronic scattering rate and superconducting energy gap to be observed. We have conducted such measurements on a thin film of MgB_2 deposited onto a sapphire substrate. The sample had a smooth appearance and a reasonably sharp transition at a temperature T_c=30K. The normal state transmission (Figure 1) shows Drude behavior with a scattering rate of about 10^{14} Hz (500 cm^{-1}). A peak in the transmission develops upon entering the superconducting state, consistent with the appearance of a BCS-like energy gap (see Figure 2). More detailed inspection reveals a number of discrepancies with simple BCS theory, such as the temperature evolution of the energy gap. This may be due to sample imperfections or the existence of a more complex gap structure (such as more than one energy gap).

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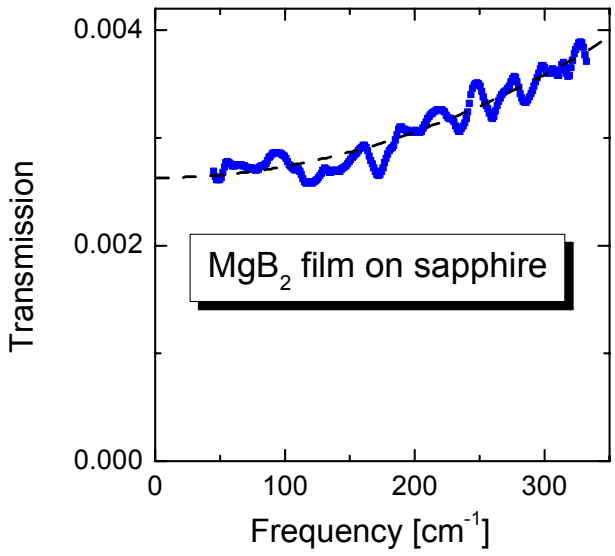

Figure 1. Transmission through the MgB_2 film at 35K (normal state).

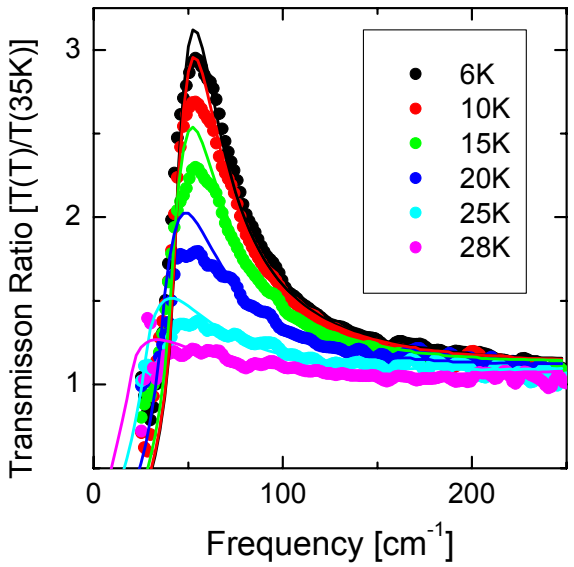

Figure 2. Transmission for various temperatures below T_c, relative to the normal state transmission.